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December 8, 1998 *CTC*/RGS-CL3478-98

U.S. Army TACOM-ARDEC
ATTN: AMSTA-AR-WET (Mr. M. Wrazen)
Building 172
Picatinny Arsenal, NJ 07806-5000

SUBJECT: Draft Final Report, (CDRL Item A001), dated December 8, 1998

REFERENCE: (1) Task No. 218, "Evaluation of Bio-Based as an Environmental Attribute," Approved October 7, 1998

(2) Contract Number DAAE30-98-C-1050

Dear Mr. Wrazen:

Concurrent Technologies Corporation (*CTC*) is pleased to submit one (1) copy of the Subject Report in accordance with the Reference (1) Task under the Reference (2) Contract.

If you should require technical clarification, please call Mr. Ronald J. Patun, Principal Technical Manager, at (814) 269-2719. For contractual issues, please call the undersigned at the above direct dial number.

Very truly yours,

// Original Signed //

Raymond G. Shrift
Manager, Contract Resources

/crm

Enclosure: as stated

cc: Ms. J. Reitman/CAAE, Suite 2533

Evaluation of Bio-Based Products as an Environmental Attribute

Final Report

DRAFT

December 8, 1998

Contract No. DAAE30-98-C-1050
Task N.218
CDRL Item A001

Prepared by
National Defense Center for Environmental Excellence (NDCEE)

Operated by Concurrent Technologies Corporation

Evaluation of Bio-Based Products as an Environmental Attribute

Final Report

DRAFT

December 8, 1998

Requests for this document shall be referred to:

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Contract No. DAAE30-98-C-1050
Task N.218
CDRL Item A001

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TABLE OF CONTENTS

LIST OF APPENDICIES

LIST OF FIGURES

LIST OF TABLES

ACRONYMS

AARC	Alternative Agricultural Research and Commercialization
AFCEE	Air Force Center for Environmental Excellence
AGAR	Agriculture Acquisition Regulation
ASTM	American Society for Testing and Materials
BEES	Building for Environmental and Economic Sustainability
BPCC	Biobased Products Coordination Council
CPG	Comprehensive Procurement Guideline
CTC	Concurrent Technologies Corporation
DLA	Defense Logistics Agency
DOD	Department of Defense
DOE	Department of Energy
DUSD(ES)	Deputy Under Secretary of Defense for Environmental Security
ECAM	Environmental Cost Analysis Methodology
ECRA	Energy Conservation Reauthorization Act of 1998
ENAC	environmental attribute code
EO	Executive Order
EPA	Environmental Protection Agency
EPACT	Energy Policy Act of 1992
EPP	environmentally preferable product
ESTCP	Environmental Security Technology Certification Program
FAR	Federal Acquisition Regulation
FLIS	Federal Logistics Information System
FSC	Federal Supply Class
GSA	General Services Administration
JG-EnvAtt	Joint Group on Environmental Attributes
LCA	life-cycle assessment
LCC	life-cycle cost
NCAUR	National Center for Agricultural Utilization Research
NDCEE	National Defense Center for Environmental Excellence
NFESC	Naval Facilities Engineering Service Center
NIST	National Institute of Standards and Technology
NREL	National Renewable Energy Laboratory
NSN	national stock number
OIT	Office of Industrial Technologies
TACOM	Tank-Automotive and Armaments Command
TARDEC	Tank-Automotive Research, Development, and Engineering Center
USDA	U.S. Department of Agriculture
VOC	volatile organic compound

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1.0 OBJECTIVE

The Joint Group on Environmental Attributes (JG-EnvAtt), headed by the Defense Logistics Agency (DLA), is leading an effort to build consensus across the federal government on the standard use of positive environmental attributes in the Federal Logistics Information System (FLIS). The objective of this initiative is **twofold: first, to reach a service-wide consensus on populating the Federal Logistics Information System with Environmental Attributes, and second,** to inform federal procurement personnel of alternative items that are environmentally preferable to conventional products. The initial focus is on commodities used by federal facilities, operations, and maintenance personnel.

This report outlines the JG-EnvAtt Steering Committee's approach for selecting and evaluating environmentally preferable products (EPPs) for display in the FLIS, a cataloging system used by government procurement personnel. The focus of this report is on the evaluation of "biobased" as an environmental attribute to be added to the FLIS. The evaluation of this potential environmental attribute may be used to introduce the goals of this initiative to procurement personnel and inform them of the EPPs available through the federal requisitioning process.

2.0 BACKGROUND

The federal government is directed by law, Executive Orders (EOs), and other federal and departmental policies to reduce waste and minimize the environmental impacts of its activities. In most cases, this task begins with the acquisition of goods and services. Through the procurement of EPPs, federal agencies can minimize the use of hazardous or toxic substances, promote the use of recycled materials, improve energy efficiency, reduce the volume of waste for disposal, improve worker health and safety, reduce operating costs, and save taxpayer dollars.

DLA was tasked by the Joint Logistics Commanders to research the possibility of adding environmental attributes to the federal acquisition process. DLA completed a business cases analysis, which concluded that over the long term, the potential benefits of increasing the federal acquisition of EPPs through the wide dissemination of environmental attribute information in the FLIS would outweigh the capital and operational costs required to modify the FLIS.

Based on the positive results of the business case analysis, DLA established the JG-EnvAtt Steering Committee to further evaluate the approach for adding environmental attributes to the FLIS. This committee is headed by DLA, with the other primary stakeholders being the Army, Navy, Air Force, Marine Corp, and the General Services Administration (GSA). Advisors include the Environmental Protection Agency (EPA), Department of Energy (DOE), and other government agencies.

This report was prepared by Concurrent Technologies Corporation (*CTC*) through the National Defense Center for Environmental Excellence (NDCEE) program, with the assistance and guidance of the JG-EnvAtt Steering Committee and the U.S. Department of Agriculture (USDA). The purpose of this report is to evaluate "biobased" as a targeted environmental attribute for addition to the FLIS. Following an approach proposed by JG-EnvAtt Steering Committee, this report highlights the underlying policy priorities, provides standard definitions and criteria, and shows the associated life-cycle benefits of this environmental attribute.

3.0 JG-ENVATT STEERING COMMITTEE APPROACH

Acquisition is the first step towards meeting pollution prevention and waste reduction goals. Federal procurement agencies have already initiated activities to encourage the procurement of EPPs. Paper catalogs and guides exist for federal procurement of environmentally preferable alternatives to conventional commodities. However, these catalogs and guides are not directly linked to the FLIS, which contains over 7 million items, each characterized by 240 code elements including national stock number (NSN), manufacturer's name, procuring agency, and standard price. These "form, fit, and function" characterization elements aid requisitioning personnel in choosing the appropriate item for their specific needs. The JG-EnvAtt Steering Committee focus is to include environmental attributes in the FLIS product characterization codes, which would provide requisitioning personnel and end users ready access to environmental information on the products they are considering for use.

3.1 Environmental Attributes

Environmental attribute codes (ENACs**) ~~would~~** consist of a two-digit alpha numeric sequence. Approximately 1300 combinations are possible, therefore, a large number of environmental attributes, and combinations of attributes, can be designated in the FLIS.

The JG-EnvAtt Steering Committee is considering thirty-one potential environmental attributes that are being evaluated for inclusion in the FLIS:

- Energy Efficient Products
- EPA CPG Items
- Biobased
- Biodegradable
- Recyclable
- Refillable
- Reusable
- Remanufacturable
- Water Conserving
- Environmental Packaging
- Non-Ozone Depleting Substance (Class I Substitutes)
- Reduced VOC Content
- Fragrance Free
- Benzene Free
- Chlorine Free
- Cadmium Free
- Lead Free
- Chromium Free
- Phosphate Free
- Vinyl Chloride Free
- Mercury Free
- Greenhouse Impacts
- Low Bioconcentration Factor
- Non-Hazardous
- Low Skin Irritation
- Compostable
- Long Shelf-Life
- Renewable
- Non-Toxic
- Non-Corrosive
- Radioisotope/Radioactive Material Substitute

3.2 Evaluation Criteria

The process for selecting and including potential environmental attributes in the FLIS involves evaluating each attribute against three criteria. As shown in Figure 1, the attributes must: (1) be a policy priority; (2) be definable; and (3) show a life-cycle cost savings (unless overridden by another requirement or policy).

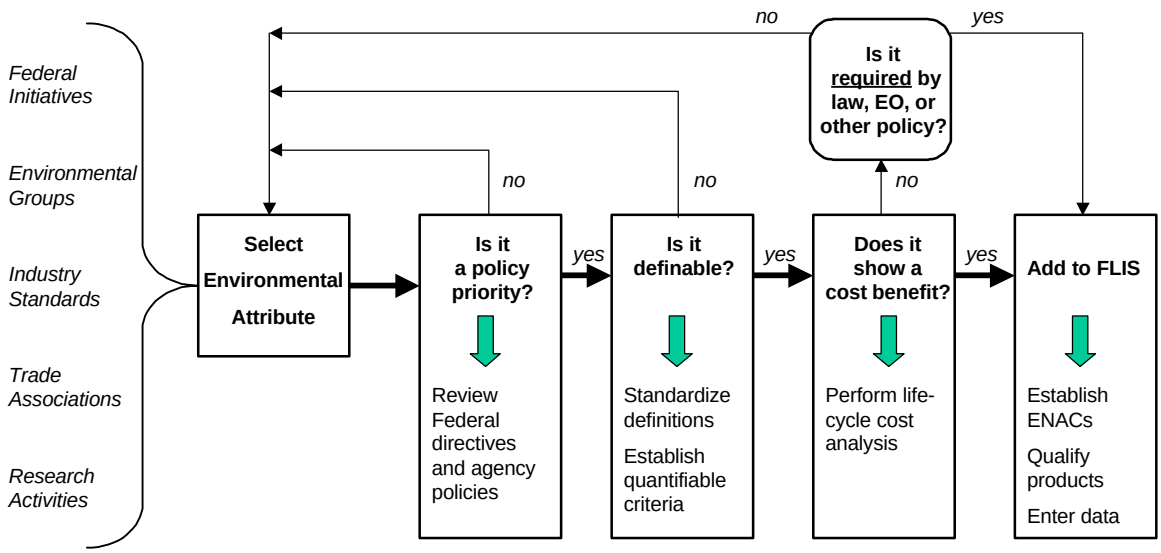

Figure 1. Approach for Adding Environmental Attributes to the FLIS

Is it a policy priority?

Federal procurement agencies must follow the rules and requirements of various environmental regulations, EOs, and other directives. Environmental regulations apply to everyone, while EOs are specifically directed at federal agencies. In addition, the Federal Acquisition Regulation (FAR) provides contracting and procurement personnel with further direction on how to implement the requirements contained in the regulations and EOs.

In addition to legal requirements, procurement agencies must also abide by departmental policies or initiatives for affirmative procurement of EPPs. Environmental stewardship programs, pollution prevention initiatives, and green design projects are other examples of activities that may support the procurement of non-hazardous or energy efficient products.

Is it definable?

The intent of adding environmental attributes to the FLIS is to aid procurement personnel in making informed purchasing decisions that reduce environmental impact. Based upon vendor claims, procurement agents must be able to identify these attributes in the wide array of products available in the database. The environmental attribute field must contribute information that is understandable and that indicates that a specific product is preferable over a similar product that performs the same function. As such, the environmental attributes must be defined clearly and include some quantifiable characteristic.

For many potential environmental attributes, definitions and values for measurable characteristics are often available from numerous sources. Environmental supporters, lawmakers, marketing departments, and industry organizations have developed definitions on various environmental attributes. However, these definitions may vary among users and often reflect a specific characteristic of the particular product or are narrowly focused to meet individual needs. Consensus on some terms has been reached, while others definitions are oriented towards a specific use for unique applications or situations.

Does it show a cost benefit?

In addition to meeting environmental and energy conservation goals, the procurement of an EPP usually results in a cost savings over the lifetime of the product. One means of quantifying this savings is to perform a life-cycle assessment (LCA), which encompasses all phases and impacts of a product from "cradle to grave." However, for the purposes of evaluating EPPs, the cost benefit analysis will be limited to include only those costs from the point of procurement through the handling, use, and recycling or disposal of the product. This is commonly known as a life-cycle cost (LCC) analysis, which differs from an LCA as shown in Figure 2.

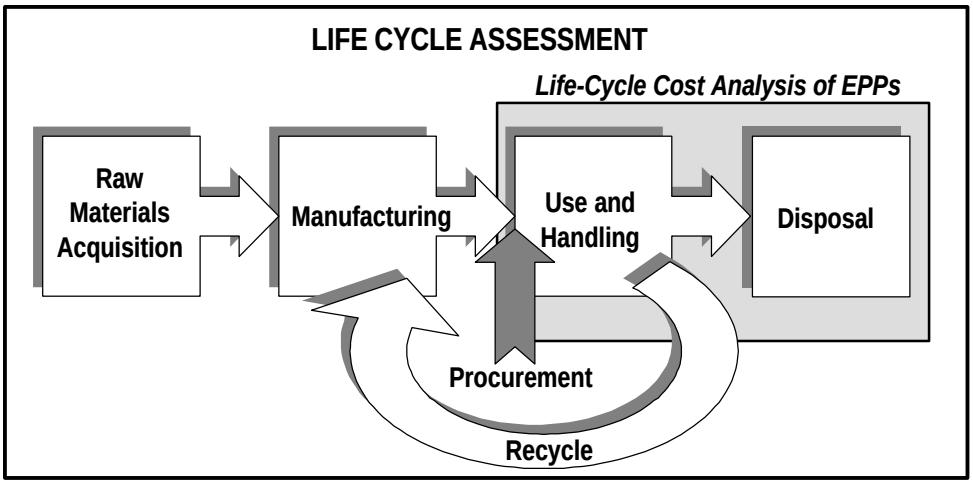

Figure 2. Boundaries for LCC Analysis of EPPs

EO 13101 and other federal directives require government agencies to consider LCCs in acquisition planning. The most significant benefits of EPPs are typically found in reducing the costs associated with:

- Material storage and handling
- Use of energy, water, and other resources
- Waste storage, treatment, and disposal
- Compliance, permitting, and reporting
- Liability for work-related injuries and environmental contamination.

For most EPPs, the overall savings is determined by weighing the cost savings for each of these criteria (over the lifetime of the product) against the purchase price of the item. In most cases, any potential increase in the purchase price is balanced by the reductions in handling, use, and disposal costs. In other cases, the results of the LCC analysis may be overridden by the requirements of a federal directive or agency policy.

3.3 Initial Focus

The JG-EnvAtt Steering Committee's intends to select and evaluate priority environmental attributes for addition to the FLIS with the intention of adding additional attributes in the future. For the initial focus of this effort, two high-priority environmental attributes were selected for evaluation: *EPA Comprehensive Procurement Guideline (CPG) items* and *energy efficient products*. Using the previously outlined approach, these two environmental attributes were evaluated based on policy priority, definability, and life-cycle cost. This evaluation was presented in the

NDCEE report titled "Evaluation of Environmental Protection Agency Comprehensive Procurement Guideline (EPA CPG) Items and Energy Efficient Products as Environmental Attributes," issued June 24, 1998. Meeting the requirements of the evaluation criteria, EPA CPG items and energy efficient products were found to be qualified environmental attributes. Based on this evaluation, the JG-EnvAtt Steering Committee recommended the addition of ENACs designating EPA CPG items and energy efficient products to the FLIS.

3.4 Focus on Biobased Products

Based on the success of qualifying the initial target environmental attributes, the JG-EnvAtt Steering Committee recommended following the same approach in evaluating other potential environmental attributes for future additions of ENACs to the FLIS.

In a meeting on July 16, 1998, the JG-EnvAtt Steering Committee selected "biobased" as one of the next priority environmental attributes to be evaluated. The results of this assessment are detailed in this report, with a focus on policy, definition, and cost.

4.0 BIOBASED PRODUCTS

Most U.S. industrial products are currently derived from fossil fuels. However, new technologies and an increasing environmental awareness are driving a shift from today's petroleum-based economy to an economy based on plant matter – a "carbohydrate economy."

The U.S. has significant biobased resources, including forestry, rangeland, and a highly productive agricultural system. These resources are currently largely focused toward food, feed, and fiber production. Only a small fraction of available biomass is currently used to produce biobased industrial products due to relatively high conversion costs. However, with heightening concern over depleting petroleum resources, there is an increasing need to make the transition to greater use of renewable materials. Biobased products have the potential to improve sustainability of natural resources, environmental quality, and national security, as well as compete economically. The 280 million tons of biomass generated in the U.S. each year is enough to meet the current demand for all industrial chemicals and materials that can be derived from biomass.

Not all biobased products are alternatives to a petroleum-based product. Some alternatives, such as paper produced from kenaf, are alternatives to "less renewable" resources (i.e., trees). These products are not necessarily intended to displace traditional sources, but rather to supplement them using an annually renewable or short rotation crop.

Many potential biobased products come from traditional crop plants being put to new uses. For example, grasses and legumes used in paper production or soybeans used to produce diesel fuel. In addition, some biobased products are being developed in an attempt to use, rather than dispose of, an agricultural waste. An example of this is the effort to identify industrial uses for rice and other cereal straws, such as biobased construction materials.

Using the approach previously outlined in Section 3.2 and Figure 1, "biobased" was evaluated to determine if the potential environmental attribute is a policy priority, definable, and shows a cost benefit.

4.1 Policy Priority

Many federal and agency directives indirectly support the acquisition of biobased products through "green" initiatives, sustainable development goals, and pollution prevention programs. However, for the purposes of this evaluation, only those federal directives that specifically support or require the procurement of biobased products will be considered.

- *Executive Order 13101, Greening the Government Through Waste Prevention, Recycling, and Federal Acquisition.* On September

14, 1998, EO 12873 was superceded by EO 13101, which strengthened the goal of improving federal use of environmentally preferable products and services. Section 402 encourages the use of set-asides and preferences for Alternative Agricultural Research and Commercialization (AARC) Corporation products, using the methods established in 7 USC 5909. Section 504 of EO 13101 directs the USDA to develop and publish a recommended biobased product list in the Federal Register within 180 days. The list shall be updated semi-annually to include additional items. Once this list has been published, federal agencies are encouraged to modify their affirmative procurement programs to give consideration to biobased products.

- *Agriculture Acquisition Regulation (AGAR).* The AGAR was amended in May 1998 to establish policy and procedures for set-asides and preferences for products developed with assistance provided by the AARC Corporation. The USDA will use these new policies and procedures to increase its acquisition of AARC supported products to the maximum extent practicable.
- *Vegetable Ink Printing Act of 1994.* Mandates that printers under government contracts use vegetable-based inks whenever possible. Following the federal government's lead, ten states have passed soy ink legislation requiring state agencies to use soy ink.
- *Energy Conservation Reauthorization Act (ECRA) of 1998:* ECRA alters the Energy Policy Act of 1992 (EPACT) by allowing the use of biodiesel to meet the requirements of federal and state fleets to purchase alternative fuel vehicles. The proposed legislation allows federal and state fleet managers to meet up to 50 percent of EPACT's alternative fuel vehicle acquisition requirements by using biodiesel added to conventional diesel at blends of 20 percent and higher.

With the introduction of EO 13101, the FAR is currently being revised to reflect the preference for EPPs, including products developed with assistance provided by the AARC Corporation. In addition, several Department of Defense (DOD) agencies are updating their policies to reflect the requirements of EO 13101. For example, the Air Force is in the process of revising the existing Pollution Prevention Air Force Instruction to bring it up to date and address the acquisition and use of EPPs, including biobased products. This work is being done at the Air Force Center for Environmental Excellence (AFCEE) at Brooks Air Force Base, with an expected completion date of April 1999.

As with EPA CPG items, federal agency procurement of biobased products will:

- Demonstrate their performance and quality
- Help to provide markets, thereby encouraging manufacturing
- Drive the development of product specifications
- Promote wider availability
- Provide a model for state and local governments
- Remove barriers to procurement and use of these products.

The federal acquisition of biobased products is supported by EO 13101, the AGAR, ECRA, and other federal agency directives. Therefore, biobased products are a policy priority and meet the requirements of the first evaluation criterion for addition to the FLIS.

4.2 Definition

> *biobased product* – a commercial or industrial product (other than food or feed) that utilizes biological products or renewable domestic agricultural (plant, animal, and marine) or forestry materials.
>
> *– EO 13101*

It is understood that this definition should not be used as a means to promote the production of industrial crops on marginal lands or to increase timber cutting in old growth forests.

Under EO 13101, the USDA has been tasked with developing a list of recommended biobased product categories by March of 1999. The Biobased Products Coordination Council (BPCC) of the USDA has established baseline criteria for biobased products, which will be further defined in the Federal Register announcement:

- Product is derived from *domestic* agricultural-based feedstock, which includes by-products and agricultural waste
- Product is derived from an alternative use for a conventional crop or from a new crop
- Product complies with EPA's Seven Guiding Principles for Environmentally Preferable Products (i.e., pollution prevention, multiple attributes, life-cycle perspective, magnitude of impact, local conditions, competition, and product attribute claims)
- Product is commonly used by government agencies
- Product meets or exceeds performance requirements
- Product must be produced from a sustainably managed resource.

The last criterion is complicated because most specifications and standards have been developed for petroleum-based products. However, many specifications are currently undergoing revision within the DOD and new American Society for Testing and Materials (ASTM) standards are being developed. In most instances, current use of biobased products have shown acceptable, and sometimes enhanced performance as compared to conventional products.

As of December 1998, the USDA has identified 7 biobased product categories for inclusion in the Federal Register announcement:

- Absorbents/Adsorbents (produced from agricultural fibers, such as cotton, cotton linters, wool, kenaf, and corn stover)
- Adhesives (starch oil-based and low VOC construction adhesives)
- Alternative Motor Fuels and Fuel Additives (including ethanol produced from agricultural residues and biodiesel produced from soybean oil)
- Construction Materials and Composites (made from agricultural crop residues or short rotation crops)
- Lubricants (including oils and greases produced from seed crops, such as soybeans, canola, or corn oil)
- Short Rotation Alternative Fiber Papers (produced from short rotation crops, such as kenaf).
- Solvents/Cleansers (citrus-based or vegetable-based)

The draft guidelines for these product categories, some example products, and potentially affected Federal Supply Class (FSC) assignments are provided in Appendix A. This is a preliminary list, which will be finalized in March 1999 and amended semi-annually to incorporate additional products and product categories as necessary. Future product categories that may be added at a later date include: starched and protein based plastics, paints and coatings, landscaping products, new fibers, enzymes and surfactants, and environmental remediation products.

The products included in the first publication of the Biobased Products List Product were developed, commercialized, or marketed (at least in part) with USDA funding, are available in the marketplace, and are known by the USDA to meet the baseline criteria described previously. For biobased products to be included in future lists, companies will have to provide the USDA with information demonstrating: (1) that the requested product is commercially available, (2) that the product claims are supportable, (3) that the product meets the minimum biobased content described in the appropriate category, and (4) that the product satisfies one or more of the EPA's EPP guidelines.

The USDA assumes that in acquiring these products, the buyer will determine whether or not the product meets the schedule, budget, and performance requirements for their particular application.

Biobased products are generally defined in EO 13101. Specific, quantifiable criteria are currently being developed by the USDA. Once the USDA publishes their recommended biobased product category list and establishes final content limits (March 1999), biobased products will meet the requirements of the second evaluation criterion for addition to the FLIS.

4.3 Cost Benefit Analysis

Historically, cost comparisons of biobased and petroleum-based products have favored the latter. The cost of large-scale production of biobased products depends on two primary factors: cost of the raw material, and cost of the conversion process. Contrary to petroleum-derived products where the cost of raw materials is typically greater than processing costs, the conversion process from raw materials usually dominates the cost of biobased products. Thus, the competitiveness of biobased products is often an issue of available technology. With further developments of new thermal, chemical, and biological processes, there is significant opportunity to expand the use of biobased renewable resources as an economically viable alternative to petroleum-based materials.

The price of biobased products fluctuates with the cost of the raw materials, which can be affected by weather, natural disasters, and other socioeconomic factors. However, the same can be said of crude oil prices. Since most U.S. petroleum comes from foreign sources, a shift to biobased products provides an added measure of national security.

Intelligence from the Economic Research Service (late 1980s and early 1990s) shows that increases in the use of biobased products from agricultural materials would have little impact on land currently in agricultural production. Therefore, it would not affect national food security or other USDA programs, such as the Conservation Reserve Program.

Many life-cycle cost analysis models are available, most of which are based on the ASTM standard LCC method and/or the environmental LCA approach specified in ISO 14000. For example, the Environmental Cost Analysis Methodology (ECAM) is the standard LCC methodology endorsed by the Environmental Security Technology Certification Program (ESTCP). Combining activity-based costing concepts with environmental cost accounting principles, ECAM addresses all of the technical and environmental factors associated with environmentally

preferable alternatives, as compared to conventional processes and materials. ECAM is a methodology; any economic or financial analysis software can be used to facilitate calculations and analysis.

The Building for Environmental and Economic Sustainability (BEES) model was developed by the National Institute of Standards and Technology (NIST) Green Buildings Program as a method for evaluating the environmental and economic performance of green building products. Environmental and economic data are combined into an overall performance measure using the ASTM standard for Multi-Attribute Decision Analysis. Sponsored by the EPA EPP Program, the BEES methodology is being refined and expanded to include data for EPPs other than building materials. Currently, NIST is using BEES to evaluate the environmental and economic aspects of biobased oil, re-refined oil, and conventional motor oil.

A full LCC analysis of all biobased products is beyond the scope of this report. However, using generalized information, a preliminary LCC analysis was performed on each USDA defined biobased product category. Qualitative LCC information is provided in Table 1 (page 14). The following qualitative factors were included in this preliminary analysis:

- Shipping and handling: typically associated with reduced product weight
- Service life: extended useful product life or time between replacement
- Material use: often relates to extended service life, but may also be associated with increased performance
- Labor: associated with use of the product
- EHS impacts: reduced health and safety risks, permitting requirements
- Waste disposal: reduced hazardous waste or volume of waste to be disposed.

In the qualitative section of Table 1, a plus sign indicates that the biobased product shows a positive impact relative to the conventional product for a particular LCC factor. A blank space indicates that there is no significant difference (positive or negative) between the biobased and conventional products for a particular LCC factor.

Based on initial purchase price, most biobased products may be more expensive than conventional products. However, as shown by the many pluses in the qualitative LCC impacts, the initial cost difference may be

outweighed by other operational advantages and environmental benefits. These additional factors each have an associated cost benefit, which should be considered in the acquisition of biobased products.

For example, the Navy did a preliminary LCC analysis of a biobased motor oil versus a conventional motor oil using the approach established in the NAVFAC Economic Analysis Handbook. The Navy study shows that the unit cost of BIO 25/30 is approximately 40 to 120 percent higher than the unit cost of a conventional 10W30 motor oil. However, the recommended miles between oil changes is 3,500 miles for the biobased oil versus 3,000 miles for the conventional motor oil. This results in reduced oil usage, reduced used oil generated for disposal, and reduced labor costs (due to less frequent oil changes). For a vehicle averaging 12,000 miles per year, use of the biobased product results in a total annual savings of $2.40 to $12.00 (per vehicle). Thus, the biobased motor oil is cost competitive with the conventional petroleum-based product.

Like the Navy, the Army and Air Force have similar LCC analysis handbooks, some of which apply to specific applications (e.g., weapons systems, or building products).

Depending on the product category, some biobased products show a life-cycle cost benefit or at least a comparable life-cycle cost. Based on a qualitative LCC analysis, some biobased products meet the third evaluation criterion for addition to the FLIS. However, a generalized statement cannot be made regarding the LCC benefits of all biobased products.

Table 1. Qualitative LCC Analysis of Biobased Products

				RELATIVE BIOBASED LCC IMPACTS[2]					
Category	**Description**	**Cost[1] (per unit)**	**Cost Difference**	**Shipping & Handling**	**Service Life**	**Material Use**	**Labor**	**EHS Impacts**	**Waste Disposal**
Absorbents/ Adsorbents	conventional	$0.45/lb, $1.55/sock, $32/boom	$0.23/lb, $0.95/sock, -$3/boom (9% less to 61% more)	+	+	+			+
	wool-based, cotton-based	$0.68/lb, $2.50/sock, $29/boom							
Adhesives	conventional	$1.65/lb	-$0.25/lb (15% less)					+	+
	biobased	$1.40/lb							
Alternative Motor Fuels and Fuel Additives	diesel, gasoline	$0.85/gal	$0.23/gal (27% more)					+	+
	biodiesel (B20)	$1.08/gal							
Construction Materials/ Composites	particle board, plywood	$0.29/ft^2 $1.37/ft^2	-$1.05/ft^2 less to $0.66/ft^2 (77% less to 228% more)	+		+	+	+	+
	cereal straw-based	$0.32/ft^2 to $0.95/ft^2							
Lubricants	petroleum-based	$0.90/qt	$0.35 to $1.05 (39% to 117% more)		+	+	+	+	+
	oil seed-based	$1.25/qt to $1.95/qt							
Short Rotation Alternative Fiber Papers	tree-based	$0.01 to $0.02 per sheet	$0.00 to $0.02 per sheet (up to 200% more)						
	kenaf-based	$0.02 to $0.03 per sheet							
Solvents/ Cleansers	petroleum or hydrocarbon-based	$0.45/lb to $1.00/lb	$0.00 to $1.00/lb (up to 100% more)					+	+
	soy-based, citrus-based	$0.45/lb to $2.00/lb							

(1) Cost information depends on specific product and application. These cost data are provided as part of a limited, preliminary analysis only. A more rigorous, detailed LCC analysis should be done for each biobased product category.

(2) a plus sign indicates that the biobased product shows a positive impact relative to the conventional product for a particular LCC factor. A blank space indicates that there is no significant difference (positive or negative) between the two products for a particular LCC factor.

5.0 SUMMARY AND CONCLUSIONS

The JG-EnvAtt Steering Committee's approach for adding environmental attributes to the FLIS is to identify and evaluate potential environmental attributes based on their policy priority, definability, and cost benefits. This approach was used to evaluate *biobased* products.

At this point in time, biobased products do not conclusively meet all of the requirements of the JG-EnvAtt evaluation criteria.

- √ Policy priority: This environmental attribute is supported (but not required) by EO 13101, AGAR, ECRA, and other federal agency policies
- Definability: Biobased products are generally defined. Specific biobased product categories and minimum agricultural/forestry content levels will be defined by the USDA by March of 1999.
- Cost benefit: Some biobased products are cost competitive, especially when including indirect cost factors. However, general cost criteria cannot be broadly applied to all biobased product categories for all applications.

Once the USDA issues the recommended biobased product list in March 1999, "biobased" will meet the definability criteria. However, the cost benefit of each biobased product category differs depending on the specific product and application. It is not possible to generally evaluate the LCC of all biobased products as a whole. Therefore, it is difficult to state that "biobased" meets the cost benefit criteria in the EPP evaluation.

These two issues aside, "biobased" should still be considered by the JG-EnvAtt Steering Committee as a potential environmental attribute for addition to the FLIS. This is supported by federal and industrial research initiatives for the development and application of biobased products. A brief overview of DOD, USDA, DOE, and industrial biobased research and development activities is provided in Appendix B. These and other technology initiatives will advance the performance and economic viability of biobased products. Support for the use of biobased products is also demonstrated by the testing and implementation of several biobased products in federal facilities. A brief summary of some of these recent projects is provided in Appendix C. In most instances, use of the biobased products highlighted in Appendix C is driven by environmental factors rather than cost factors. However, above all, it is apparent that performance is the key criteria for final acceptance of a biobased product (or any product for that matter).

This report will be updated and revised upon publication of the USDA Biobased Product List in March 1999. At that time, the JG-EnvAtt Steering Committee should carefully consider the USDA guidelines and all of the issues discussed in this report before accepting "biobased" as a viable environmental attribute for addition to the FLIS.

6.0 REFERENCES

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APPENDIX A

Draft USDA Biobased Product List

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(final guidelines to be published in Federal Register, March 1999)

BIOBASED PRODUCT CATEGORY	GUIDELINES	PRODUCT EXAMPLES*	FEDERAL SUPPLY CLASS
Absorbents/Adsorbents *(environmental preferability of the entire product – absorbent/adsorbent and casing – must be addressed by the buyer)*	• Minimum 90% by weight agricultural fibers, such as cotton, cotton lint, wool, kenaf, corn stover, or other crop residues	TBD	4235 Hazardous Material Spill Containment Cleanup Equipment and Material 9420 Fibers: Vegetable, Animal and Synthetic
Adhesives	• Starch oil based adhesives • Low VOC construction adhesives	• Union Camp	8040 Adhesives
Alternative Motor Fuels and Fuel Additives *Biodiesel* *Ethanol*	 • Diesel fuel made from plant based oils or animal fats • Minimum of 20% by volume splash blend (B20) TBD	 TBD TBD	9140 Fuel Oils
Construction Materials/Composites	• Minimum 41% agricultural crop or crop residue content (by weight or volume) • Agricultural component must be a crop or crop residue produced from short rotation crops (<10 years) • Products produced from recycled agricultural wastes need not meet the short rotation crop requirement • Manufacturing process must provide extremely low or no off-gassing of volatile organic compounds	• PrimeBoard, Inc. (wheat straw board) • Gridcore Systems International • Phenix Biocomposites (Environ) • Agriboard Industries, Inc. (wheat straw load bearing panels)	5410 Prefabricated Portable Buildings 5411 Rigid Wall Shelters 5450 Misc. Prefab Structures 5510 Lumber and Related Basic Wood Materials 5520 Millwork 5530 Plywood and Veneer 5610 Mineral Construction Materials, Bulk 5620 Building Glass, Tile, Brick Clock 5640 Wallboard, Building Paper, Thermal Insulation Materials 5670 Building Components Prefabricated 5675 Non-Wood Construction, Lumber, and Related Material 5680 Misc. Construction Materials 7105 Household Furniture 7110 Office Furniture 7125 Cabinets, Lockers, Bins, and Shelving 9905 Signs, Advertis, Displays, and ID Plates

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(final guidelines to be published in Federal Register, March 1999)

BIOBASED PRODUCT CATEGORY	GUIDELINES	PRODUCT EXAMPLES*	FEDERAL SUPPLY CLASS
Lubricants *(includes engine, all purpose, hydraulic, gear, wire rope, transmission, and cutting oils)*	• Minimum 51% biobased content (from seed crops, such as soybeans, canola, or corn oil)	• International Lubricants, Inc. (series of seed based oil products) • University of Northern Iowa (BIOSOY) • Agro Management Group, Inc. (lubricants for small and high performance engines) • University of Nebraska (drip irrigation soy-based lubricant) • Leahy-Wolf (Bioform, concrete release agent)	9150 Oils and Greases 9160 Misc. Waxes, Oils, and Fats
Short Rotation Alternative Fiber Papers *Kenaf* *Other fibers*	• Minimum 30% recycled fiber content without distinguishing between pre- or post-consumer wastes • Must use less (or zero) chlorine in production than traditional tree fiber papers TBD	• KP Products, Inc. (VISION and REVISION papers)	9310 Paper and Paperboard
Solvents/Cleansers *Solvents* *Cleansers*	• Minimum 51% biobased content • Minimum 51% biobased content	• Shadow Lake, Inc. (Citra-Solv and other products) • Interchem Environmental, Inc. (Soyclean) • MM Manufacturing (SavySoap)	7930 Cleaning and Polishing Components and Prep 8520 Toilet Soap, Shave Prep and Dentifrices

*Preliminary information. Additional product and sales information to be provided in the Federal Register announcement.

APPENDIX B

Biobased Research and Development Activities

BIOBASED RESEARCH AND DEVELOPMENT ACTIVITIES

Plant/Crop Based Renewable Resources 2020 is a strategic vision developed through the cooperative efforts of the U.S. agricultural, forestry, and chemical communities. The vision establishes far-reaching goals for the use of agricultural resources for consumer products:

- Displace at least 10 percent of petroleum with plant/crop resources as the basic building block for consumer products by the year 2020, and provide the concepts needed to displace as much as 50 percent by the year 2050
- Establish a plant/crop-based manufacturing infrastructure
- Establish the partnership between industry, government, and academia for the research and development needed to achieve market opportunities, and insure that processes and systems are commercially viable.

The following federal and industrial research initiatives support the goals of Vision 2020.

DOD

The Secretary of Defense and the Secretary of Agriculture have signed a Master Memorandum of Understanding expressing their support of a partnership between the DOD and USDA to coordinate research activities in the areas of food and agricultural sciences, pest management, nutrition, and other areas of mutual interest (e.g., forestry and wildlife). Under this mutual agreement, work relevant to DOD needs will be undertaken by the USDA, and work responsive to USDA needs will be undertaken by the DOD.

USDA

The Biobased Products Coordination Council (BPCC) promotes the research, development, and commercialization of biobased industrial products. Under EO 13101, the BPCC is tasked with developing a list of recommended biobased product categories by March 1999. Ten USDA agencies are members of the Council: Forest Service; Agricultural Research Service; Cooperative State Research, Education, and Extension Service; Office of Energy Policy and New Uses; the AARC Corporation; Foreign Agricultural Service; Natural Resources Conservation Service; Agricultural Marketing Service; Rural Business-Cooperative Service; and the USDA Assistant Secretary for Administration.

In addition to the efforts associated with the BPCC, USDA is engaged in research and development activities that are conducted in-house, at land grant universities and colleges, and through the AARC Corporation. The National Center for Agricultural Utilization Research (NCAUR) is the designated lead USDA Technology Transfer Facility. NCAUR works to accelerate the commercialization of promising products and technology, bring them out of the lab and into the marketplace.

DOE

Through the Industries of the Future initiative, the DOE Office of Industrial Technologies (OIT) has identified agriculture as a target industry, with emphasis on partnerships to develop technologies for using plants, crops, and their wastes as feedstocks for industrial products. The basis of OIT's partnership with industry is to improve energy efficiency, promote environmentally sound industries, and enhance economic well-being.

Much of the research in biomass energy sources is supported by the DOE National Renewable Energy Laboratory (NREL). The DOE also supports research and development partnerships for biomass electrical power through the Office of Utility Technologies and research on biobased fuels through the Office of Transportation Technologies.

Industry

The New Uses Council is a nonprofit membership organization dedicated to expanding the development and commercialization of new industrial, energy, and non-food consumer uses of renewable agricultural products.

A wide variety of agricultural trade associations also support plant/crop based research, particularly for biobased products made from corn, wheat, rice, soybeans, and cotton.

Individual companies are also investing research and development funds to introduce and improve biobased products and processes. With the advancement of technologies for processing agricultural crops and residues into usable commodities, biobased products should become more available and cost competitive.

APPENDIX C

Current Use of Biobased Products in Federal Facilities

CURRENT USE OF BIOBASED PRODUCTS IN FEDERAL FACILITIES

DOD

Under the sponsorship of the AARC Corporation, the Naval Facilities Engineering Service Center (NFESC) is evaluating the potential use of a number of biobased products within the Navy. Eleven biobased products produced by ten companies were selected to undergo a two-phase evaluation process. In the first phase, NFESC conducted a preliminary evaluation of selected biobased products. These products include a seed-oil based lubricant; motor oil derived from canola; kenaf, cotton, and wool absorbents; biobased construction materials; a citrus-based cleaner/degreaser; and a micro-emulsion fuel additive that reduces diesel emissions. In the second phase of the evaluation, NFESC will test the most promising products under controlled conditions, evaluate their life-cycle costs, and identify the best opportunities for introducing the products into the Navy and other services.

Several biobased cleaning products have been tested by the Army. A soy-based solvent was successfully tested for use as a substitute for current degreasers in military vehicle degreasing operations. A citrus peel-based solvent was also tested for specific cleaning applications.

The U.S. Army Tank-Automotive Research, Development, and Engineering Center (TARDEC), Warren, MI, is testing several biobased (canola, soybean, and rapeseed oil-based) hydraulic fluids for use in construction equipment. These biobased products are currently undergoing field testing at Fort Bliss. In another study, the U.S. Army TARDEC Fuels and Lubricants Research Facility of Southwest Research Institute is conducting an evaluation of biodiesel fuel for use in military ground equipment. The study includes an assessment of biodiesel/materials compatibility, fuel blend characteristics, engine dynamometer evaluations, pilot field demonstrations, and a full field demonstration.

U.S. Army Natick RD&E Center is researching biobased polymers and starch-based films for packaging, coated paper products (cups, plates, and bags) and injection molded utensils. In addition, they are conducting a study of emulsan, a bioemulsifier, for degreasing applications. Many of these efforts also benefit the Navy's goals in meeting an international marine pollution treaty.

Other Federal Agencies

Construction materials manufactured from agricultural fibers and recycled materials were successfully used in constructing the U.S. Post Office building in Fort Worth, TX, and the Internal Revenue Service building in Kansas City, MO.